We claim:

1. A method for stabilizing metals in a particulate material comprising the steps of:

   a) contacting a metal reagent with the particulate material, said particulate material having a solids content of greater than about seventy-five weight percent;

   b) contacting a sulfur-containing compound with the particulate material; and,

   c) agitating the particulate material to entrain oxygen in the particulate material.

2. A method according to claim 1 wherein the metals in the particulate material that are to be stabilized are selected from the group consisting of mercury, arsenic, lead, zinc, barium, cadmium, chromium, selenium, silver and mixtures thereof.

3. A method according to claim 1 wherein the particulate material has a mercury content of greater than about 260 ppm.

4. A method according to claim 1 comprising the additional step of adding a dispersing agent to the soil.

5. A method according to claim 1 comprising the additional step of treating the metal reagent with an activator.

6. A method according to claim 1 comprising the additional step of adding an iron-containing compound to the particulate material to react with excess sulfides in the particulate material.

7. A method according to claim 1 wherein the sulfur-containing compound is a dimethylthiolcarbamate, diethylthiolcarbamate, sulfide, polysulfide or mixtures thereof.

8. A method according to claim 1 wherein the metal reagent is selected from the group consisting of metal based elements from Group 1B, Group 2B, Group 8B, Group 4A and combinations thereof of a Periodic Table of Elements.

9. A method according to claim 1 wherein the metal reagent is selected from the group consisting of zinc, tin, copper, titanium, lead and mixtures thereof.

10. A method according to claim 1 wherein the metal reagent is tin.

11. A method according to claim 5 wherein the activator is a mineral containing acid.

12. A method according to claim 5 wherein the activator is a sulfur-containing acid.

13. A method according to claim 5 wherein the activator is selected from the group consisting of sulfamic acid, sulfamidic acid, sulfonic acid, sulfinic acid, sulfenic acid, and mixtures thereof.

14. A method according to claim 5 wherein the activator is sulfamic acid.

15. A method according to claim 6 wherein a pH level of the particulate material is in a range of approximately pH 4 to pH 8.

16. A method according to claim 15 wherein the pH level of the particulate material is raised following the addition of the sulfur-containing compound.

17. A method according to claim 17 wherein the pH level of the particulate material is approximately neutral following the addition of the iron-containing compound.

18. A method according to claim 1 wherein approximately 0.4 to 2.0 weight percent of the metal reagent is added per kilogram of particulate material.

19. A method according to claim 1 wherein the sulfur-containing compound is added in an amount ranging from about 1.0 mole to about 2.0 mole of sulfur-containing

compound per mole of mercury to about 300 ppm of metals to about 1000 ppm of metals.

20. A method according to claim 1 wherein the sulfur-containing compound is added in the an amount ranging from about 2.0 mole to about 3.0 mole of sulfur-containing compound per mole of mercury to about 1000 ppm of metals to about 3000 ppm of metals.

21. A method according to claim 1 wherein the particulate material is selected from the group consisting of soil, sand, dirt, sludge, solid wastes and mixtures thereof.

22. A method according to claim 6 wherein the iron-containing compound is selected from the group consisting of elemental iron, ferric chloride, ferric sulfate, ferrous sulfate and mixtures thereof.

23. A method according to claim 4 wherein the dispersing agent is a surfactant.

24. A method according to claim 4 wherein the dispersing agent is a detergent.

25. A method for stabilizing metals in a particulate material comprising the steps of:

a) treating a metal reagent with an activator;

b) adding a dispersing agent to the particulate material;

c) adding a metal reagent to the particulate material, said particulate material having a solids content of greater than about seventy-five weight percent;

d) adding a sulfur-containing compound to the particulate material;

e) agitating the particulate material to entrain oxygen in the particulate material;

f) adding an iron-containing compound to the particulate to react with excess sulfides in the particulate material.

26. A method according to claim 25 wherein the metals in the particulate material that are to be stabilized are selected from the group consisting of mercury, arsenic, lead, zinc, barium, cadmium, chromium, selenium, silver and mixtures thereof.

27. A method according to claim 25 wherein the particulate material has a mercury content of greater than about 260 ppm.

28. A method according to claim 25 wherein the sulfur-containing compound is calcium sulfate, dithiolcarbomate, dimethylcarbomate, sulfide, polysulfide or and mixtures thereof.

29. A method according to claim 25 wherein the metal reagent is selected from the group consisting of metal based elements from Group 1B, Group 2B, Group 8B, Group 4A and combinations thereof of a Periodic Table of Elements.

30. A method according to claim 25 wherein the metal reagent is selected from the group consisting of zinc, tin, copper, titanium, lead and mixtures thereof.

31. A method according to claim 25 wherein the metal reagent is tin.

32. A method according to claim 25 wherein the activator is a mineral containing acid.

33. A method according to claim 25 wherein the activator is a sulfur-containing acid.

34. A method according to claim 25 wherein the activator is selected from the group consisting of sulfamic acid, sulfamidic acid, sulfonic acid, sulfinic acid, sulfenic acid and mixtures thereof

35. A method according to claim 25 wherein the activator is sulfamic acid.

36. A method according to claim 25 wherein a pH level of the particulate material is in a range of approximately pH 4 to pH 8.

37. A method according to claim 36 wherein the pH level of the particulate material is raised following the addition of the sulfur-containing compound.

38. A method according to claim 37 wherein the pH level of the particulate material is approximately neutral following the addition of the iron-containing compound.

39. A method according to claim 25 wherein approximately 0.4 to 2.0 weight percent of the metal reagent is added per kilogram of particulate material.

40. A method according to claim 25 wherein the sulfur-containing compound is added in an amount ranging from about 1.0 mole to about 2.0 mole of sulfur-containing compound per mole of mercury to about 300 ppm of metals to about 1000 ppm of metals.

41. A method according to claim 25 wherein the sulfur-containing compound is added in the an amount ranging from about 2.0 mole to about 3.0 mol of sulfur-containing

compound per mole of mercury to about 1000 ppm of metals to about 5000 ppm of metals.

42. A method according to claim 25 wherein the particulate material is selected from the group consisting of soil, sand, dirt, sludge, solid wastes and mixtures thereof.

43. A method according to claim 25 wherein the iron-containing compound is selected from the group consisting of elemental iron, ferric sulfate, ferric chloride, ferrous sulfate and mixtures thereof.

44. A method according to claim 25 wherein the dispersing agent is a surfactant.

45. A method according to claim 25 wherein the dispersing agent is a detergent.

46. A composition of stabilized metals in a particulate material comprising:

a metal reagent amalgamated with a contaminant metal to be stabilized in the particulate materials; and,

an insoluble contaminant metal sulfide.

47. A composition according to claim 46 further comprising a flow enhancing agent, said flow enhancing agent making the composition granular.

48. A composition according to claim 46 further comprising a polymeric agent, said polymeric agent making the composition solid.

49. An apparatus for stabilizing metals in a particulate material comprising:

means for applying a metal reagent to the particulate material;

means for applying a sulfur-containing compound to the particulate materials; and,

agitating means for entraining oxygen into the particulate material.

50. An apparatus according to claim 49 further comprising means for applying an iron-containing compound to the particulate material.

51. An apparatus according to claim 49 further comprising means for applying a dispersing agent to the particulate material.

52. An apparatus for stabilizing metals in a particulate material comprising:

means for applying a metal reagent to the particulate material;

means for applying a sulfur-containing compound to the particulate material; and,

means for impregnating the particulate material with oxygen.

53. An apparatus according to claim 52 further comprising means for applying a dispersing agent to the particulate material.

54. An apparatus according to claim 52 further comprising means for applying an iron-containing compound to the particulate material.

55. An apparatus for stabilizing metals in a particulate material comprising:

a first applicator, said first applicator being capable of applying a metal reagent to the particulate material;

a second applicator, said second applicator applying a sulfur-containing compound to the particulate material; and,

a mixer, said mixer being applied to the particulate material to mix the particulate material, the sulfur-containing compound and the metal reagent, said mixer also entraining oxygen into the particulate material.

56. An apparatus according to claim 55 further comprising a third applicator, said third applicator being capable of applying a dispersing agent to the particulate material.

57. An apparatus according to claim 55 further comprising a fourth applicator, said fourth applicator being capable of applying an iron-containing compound to the particulate material.

58. An apparatus according to claim 56 wherein the first, second and third applicators can be combined into one device such that the metal reagent, the sulfur-containing compound, and the dispersing agent are applied to the particulate material simultaneously.

59. An apparatus according to claim 57 wherein the first, second and fourth applicators can be combined into one device such that the metal reagent, the iron-containing compound, and the sulfur-containing compound are applied to the particulate material simultaneously.

60. A composition useful for stabilizing metals in a particulate material comprising:

a metal reagent;

a sulfur-containing compound; and,

an oxygen-containing compound.

61. A composition according to claim wherein claim 60 wherein the sulfur-containing compound is calcium sulfate, dithiolcarbomate, dimethylcarbomate, sulfide, polysulfide or mixtures thereof.

62. A composition according to claim 60 wherein the metal reagent is selected from the group consisting of metal based elements from Group 1B, Group 2B, Group 8, Group 4A and combinations thereof of a Periodic Table of Elements.

63. A composition according to claim 60 wherein the metal reagent is selected from the group consisting of zinc, tin, copper, titanium, lead and mixtures thereof.

64. A composition according to claim 60 wherein the metal reagent is tin.

65. A method for stabilizing metals in a particulate compound comprising the steps of:

a) adding a metal reagent to the particulate material, said particulate material having a solids content of greater than about seventy-five weight percent;

b) adding a sulfur-containing compound to the particulate material;

c) impregnating the particulate material with oxygen;

d) agitating the particulate material to entrain oxygen in the particulate material; and,

e) adding an iron-containing compound to the particulate to remove excess sulfides from the particulate material.

66. A method for stabilizing metals in a particulate compound comprising the steps of:

a) adding a metal reagent to the particulate material, said particulate material having a solids content of greater than about seventy-five weight percent;

b) adding a sulfur-containing compound to the particulate material;

c) agitating the particulate material to entrain oxygen in the particulate material; and,

d) adding an iron-containing compound to the particulate to remove excess sulfides from the particulate material.

67. A method for stabilizing metals in a particulate material comprising the steps of:

a) adding a dispersing agent to the particulate material;

b) adding a metal reagent to the particulate material, said particulate material having a solids content of greater than about seventy-five weight percent;

c) adding a sulfur-containing compound to the particulate material;

d) agitating the particulate material to entrain oxygen in the particulate material; and,

e) adding an iron-containing compound to the particulate to remove excess sulfides from the particulate material.

68. A method for stabilizing metals in a particulate material comprising the steps of:

a) adding a metal reagent to the particulate material, said particulate material having a solids content of greater than about seventy-five weight percent;

b) adding a sulfur-containing compound to the particulate material; and,

c) impregnating the particulate material with oxygen.

69. A method for stabilizing metals in a particulate material comprising the steps of:

a) adding a metal reagent to the particulate material, said particulate material having a solids content of greater than about seventy-five weight percent;

b) adding a sulfur-containing compound to the particulate material; and,

c) impregnating the particulate material with oxygen by adding an oxygen-containing compound to the particulate material.

70. A method for stabilizing metals in a particulate material comprising the steps of:

a) adding a dispersing agent to the particulate material;

b) adding a metal reagent to the particulate material, said particulate material having a solids content of greater than about seventy-five weight percent;

c) adding a sulfur-containing compound to the particulate material;

d) agitating the particulate material to entrain oxygen in the particulate material; and,

e) adding an iron-containing compound to the particulate to remove excess sulfides from the particulate material.